Sept 2003 - Sept 2004

15427

1. Advanced Membrane Filtration Technology for Cost Effective Recovery of Fresh Water from Oil & Gas Produced Brine

15543

2. New Cleaning Agents for Membrane Filters used to Treat Oil Field Produced Water for Beneficial Purposes

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Texas Water Resources Institute, Texas A&M

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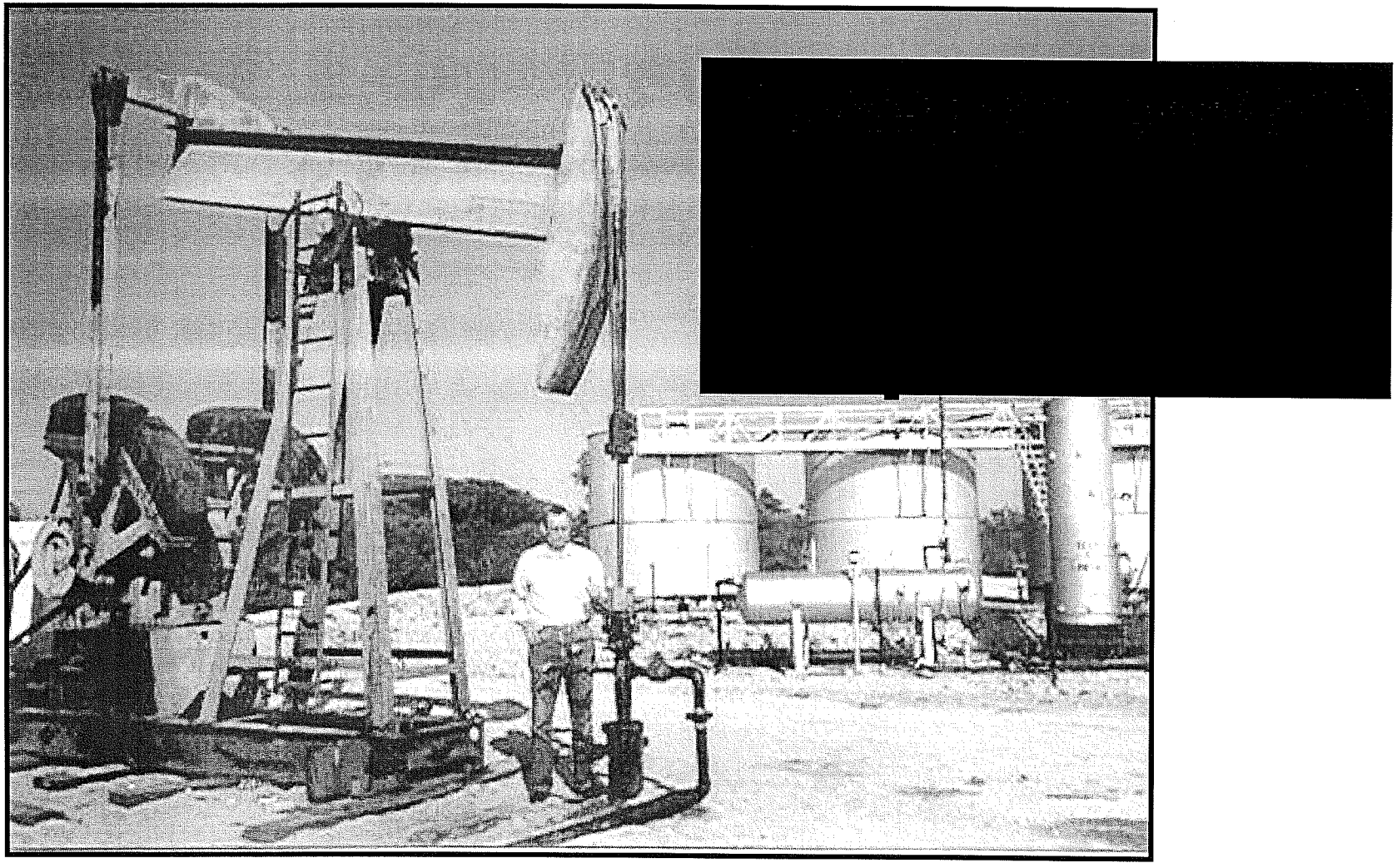
The A&M Program: What We Do

- *Science & Engineering Colleges*
  - Develop new technologies, basic and applied research
- *Texas Water Resources Institute*
  - Provides leadership and serves as link between technology development and incorporation of new technology into public sector
  - Connection with Business interests
- *International Agriculture*
  - Provides education, research and technology transfer internationally
  - Connection with private sector, NGOs, universities, and governments

For more Info see: http://www.tamu.edu

Production Operation in West Texas

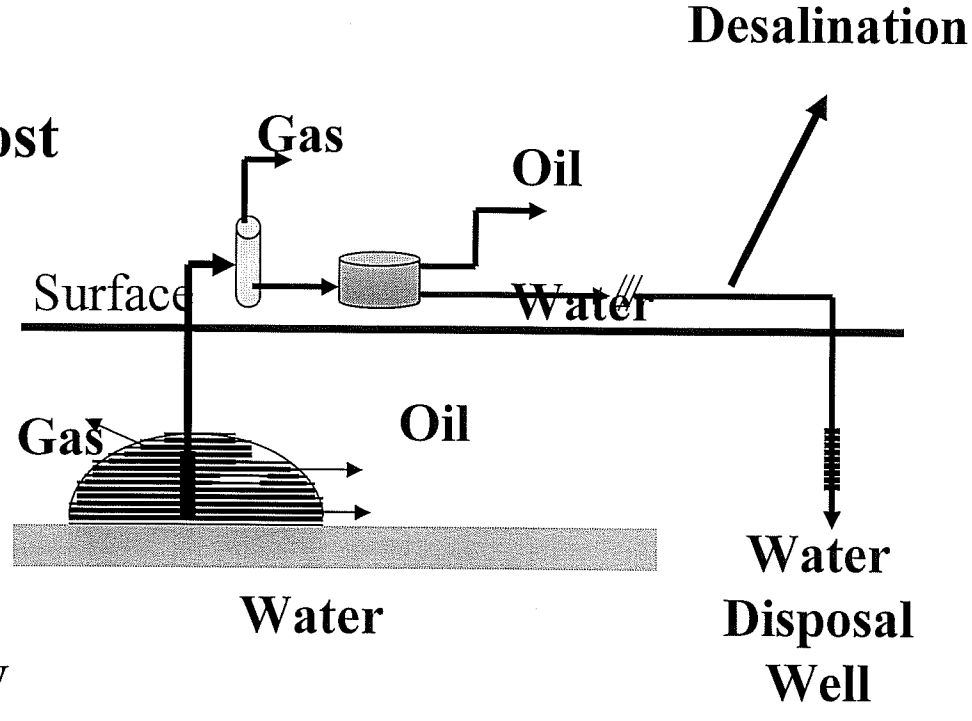


Review:

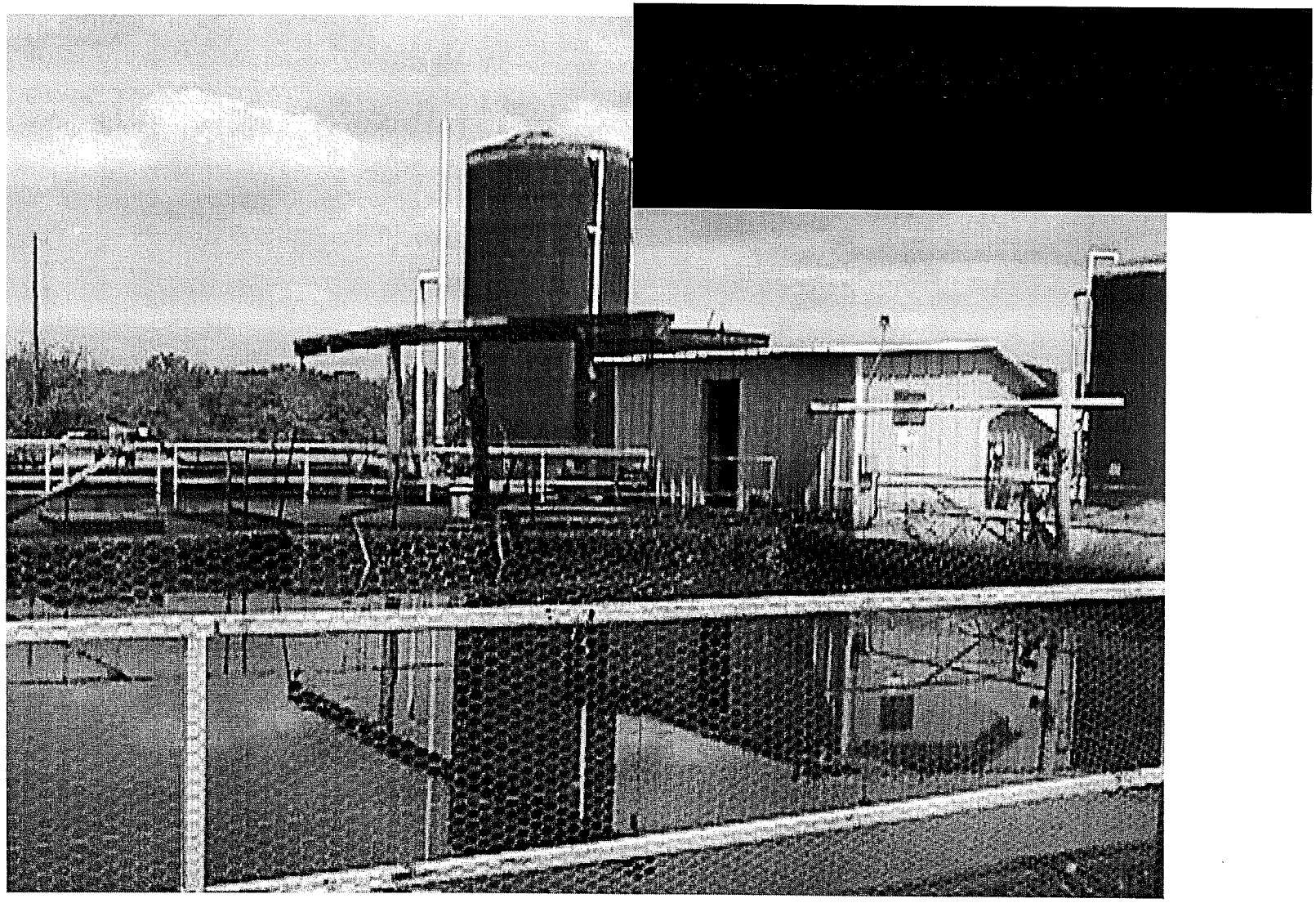
Saline Water Injection into Oil and Gas Zones

Brine disposal represents a significant fraction of the cost of operating a desalination facility.

In the oil and gas industry, high salinity brines are routinely injected into formations for pressure maintenance and secondary recovery by water flooding.

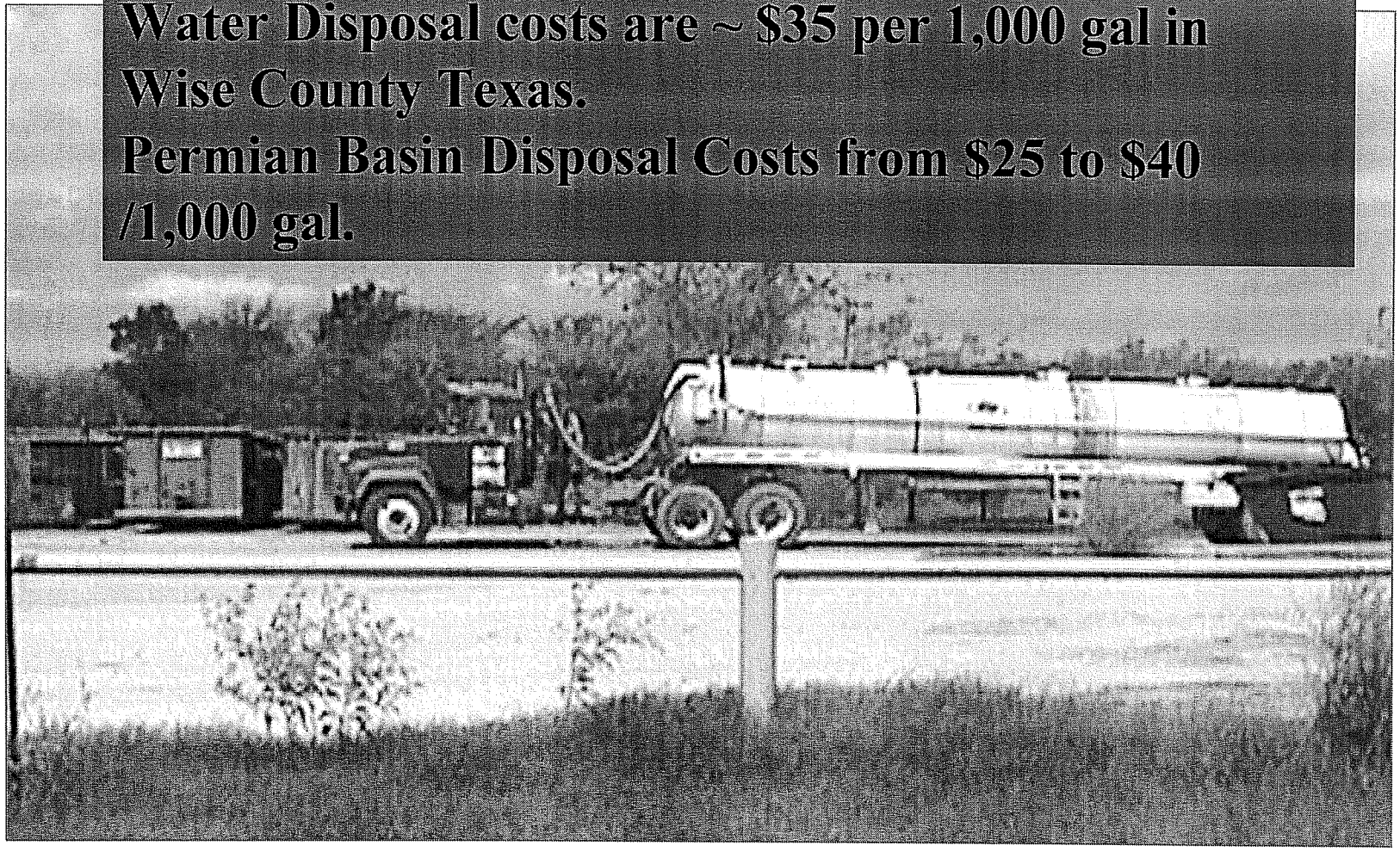


Example of Oil Field Brine Disposal Facility



Water Hauling Costs are Greater than Desalination Costs

Water Disposal costs are ~ $35 per 1,000 gal in Wise County Texas.
Permian Basin Disposal Costs from $25 to $40 /1,000 gal.



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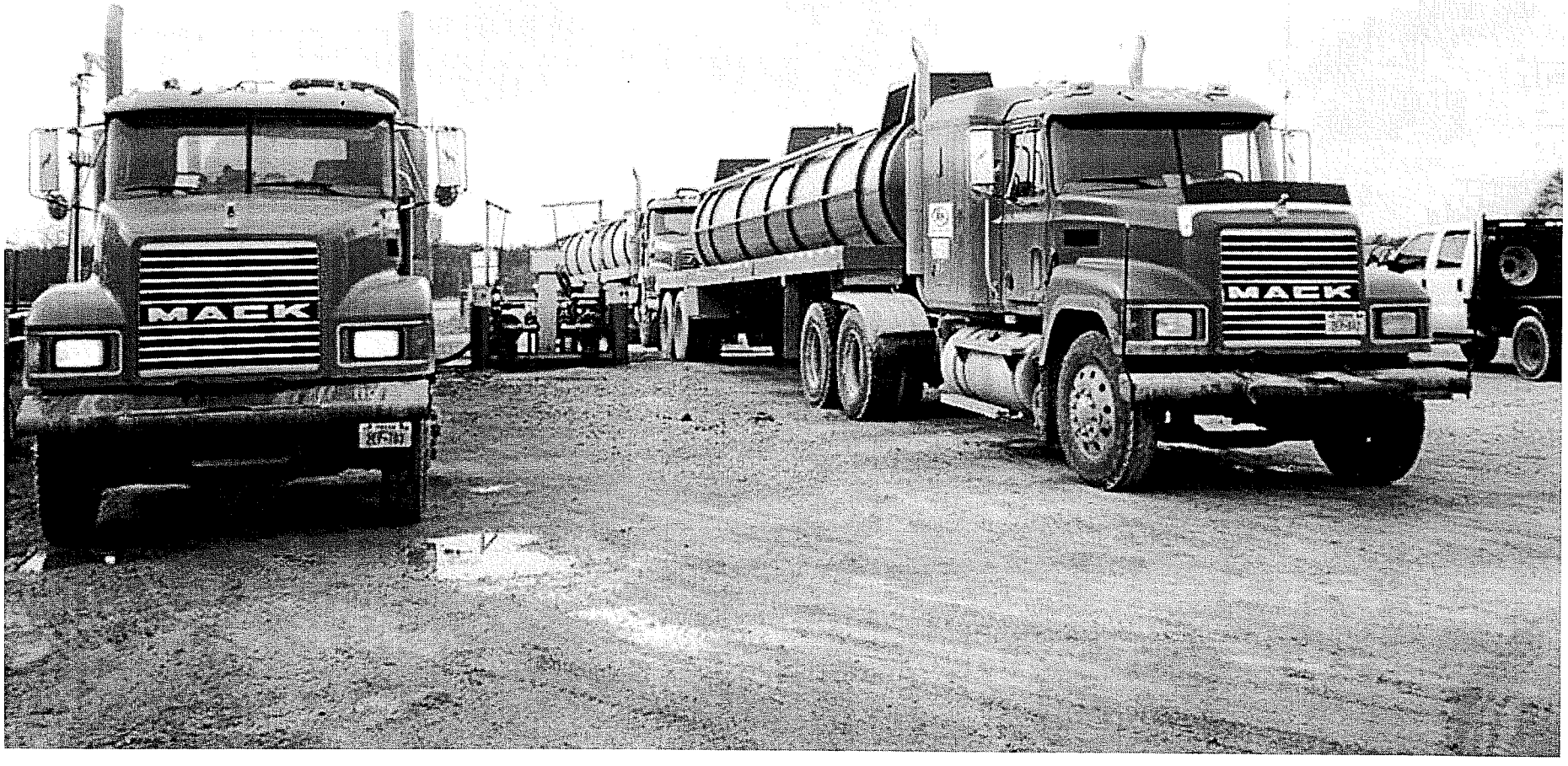

MACK
MACK

Statement of the Problem

Can you sell oil field produced water?

What do you have to do to show that desalinated produced water has value?

What is that value?

What is the cost of treatment?

Complicating Factors

Produced Water Highly Variable Composition

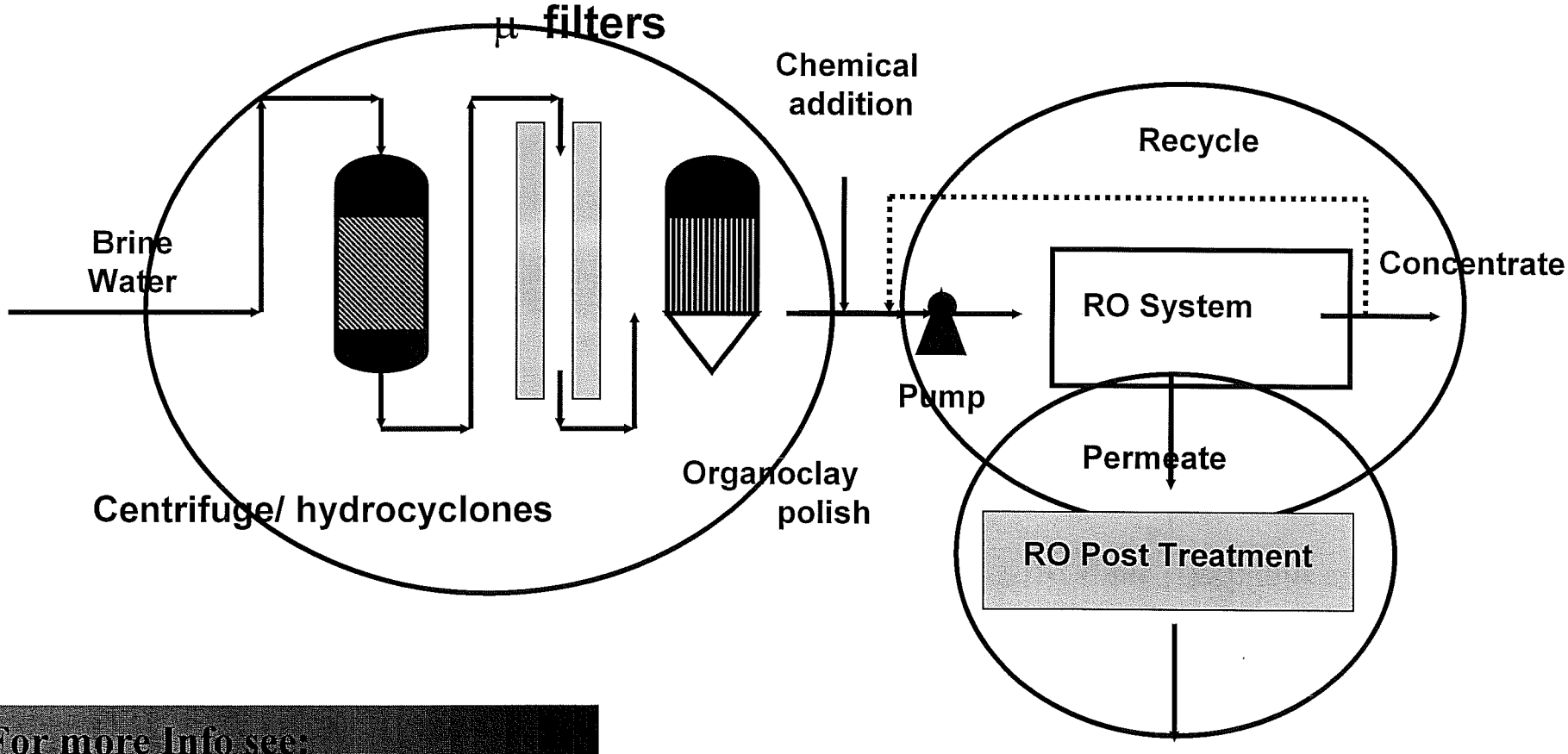
Water Produced in Remote Locations

What do you use the Fresh Water for?

How can you get a permit to operate?

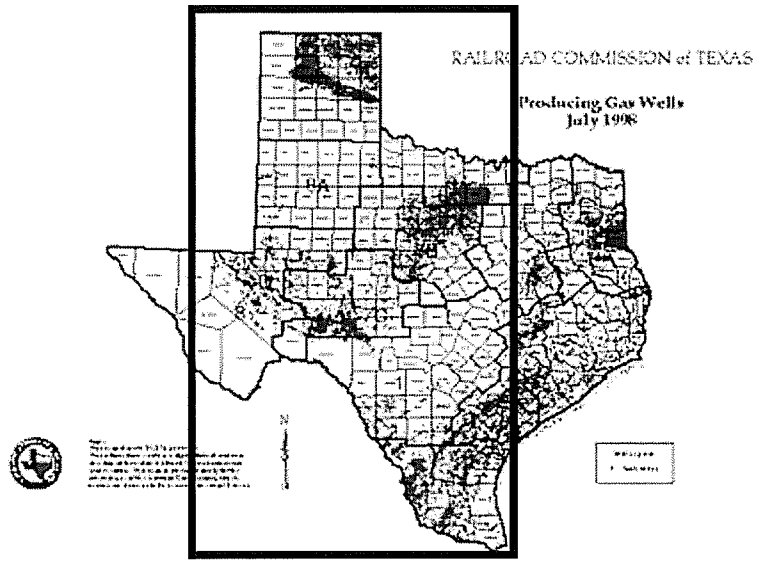
2. Description of the Technology

BGW Desalination Process

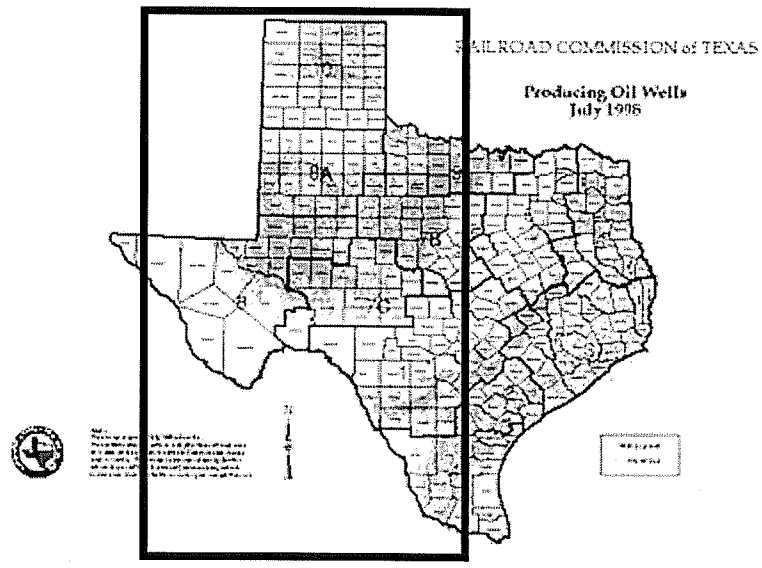


For more Info see:

Oil and Gas Production in Texas



Oil Wells



Gas Wells

In 2003 there were more than 300,000 wells permitted to operate in Texas. Approximately 100,000 are shut in.* These wells produce more than 500 million gallons of water a day.

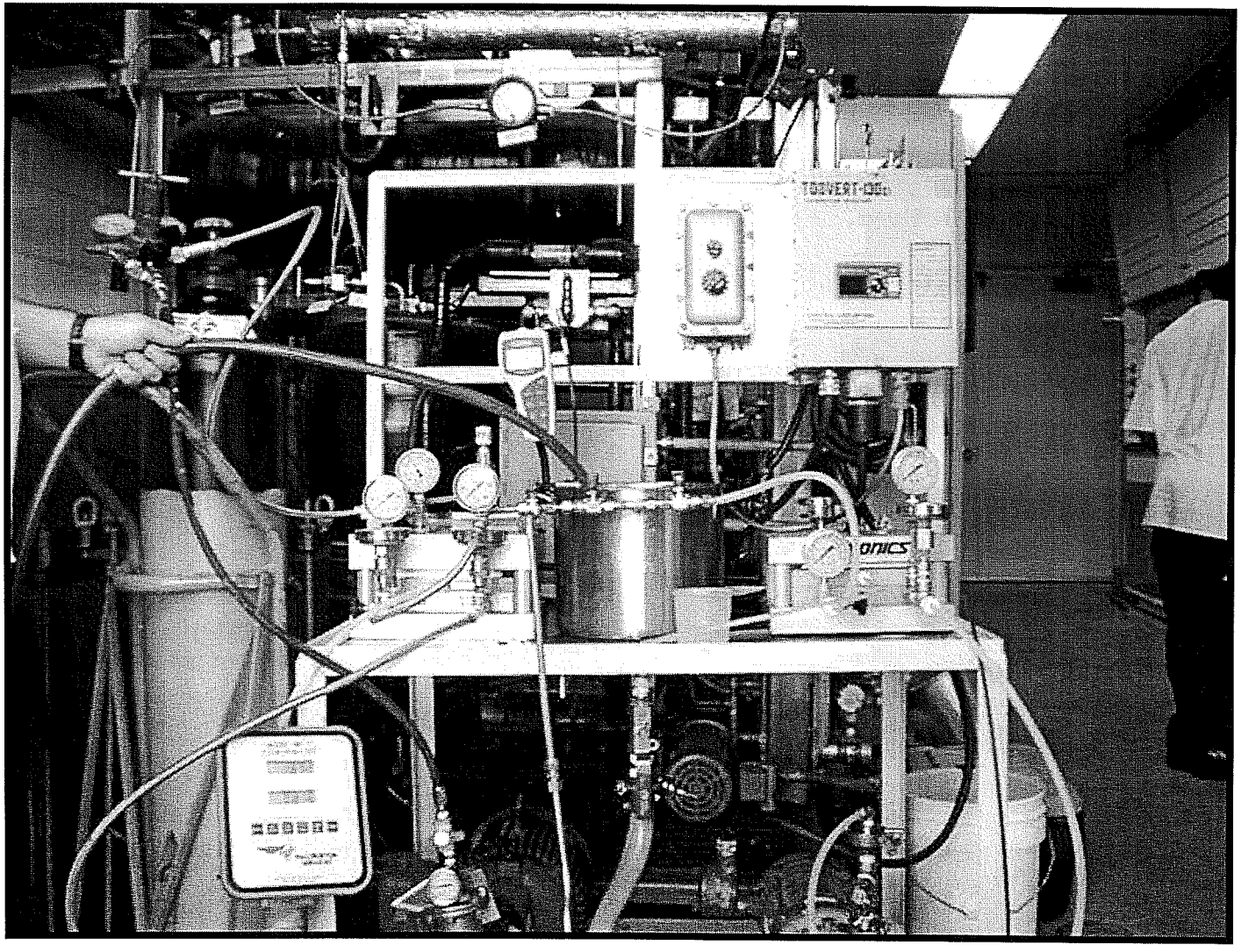
Beneficial Re-use of Produced Water

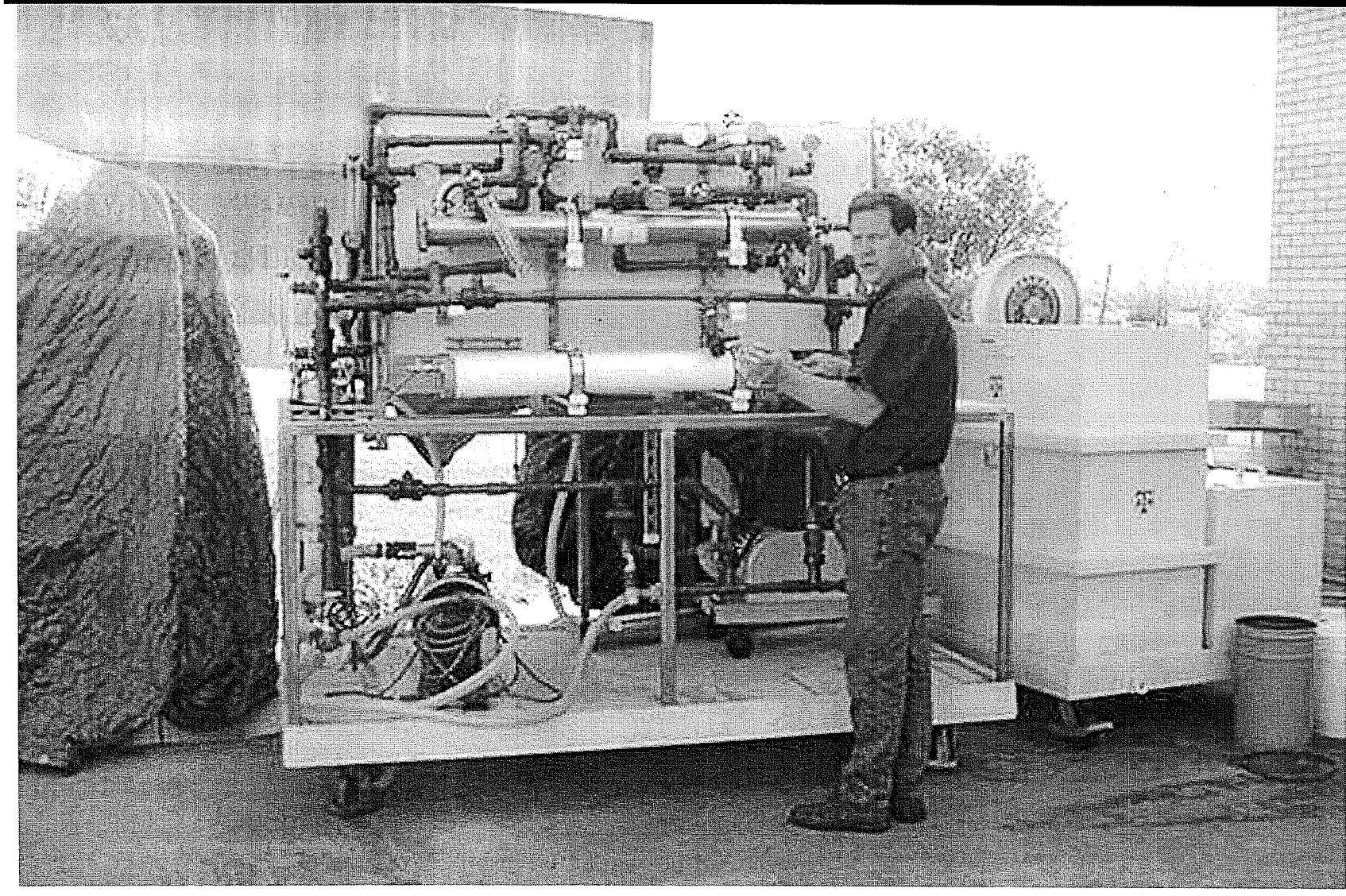
- ***Desalination to produced fresh water for agri-industry***

- ***"Conditioning" saline water for oil field re-use (fracturing fluids, weighting brines)***

- ***Make-up brine for waterflooding operations***

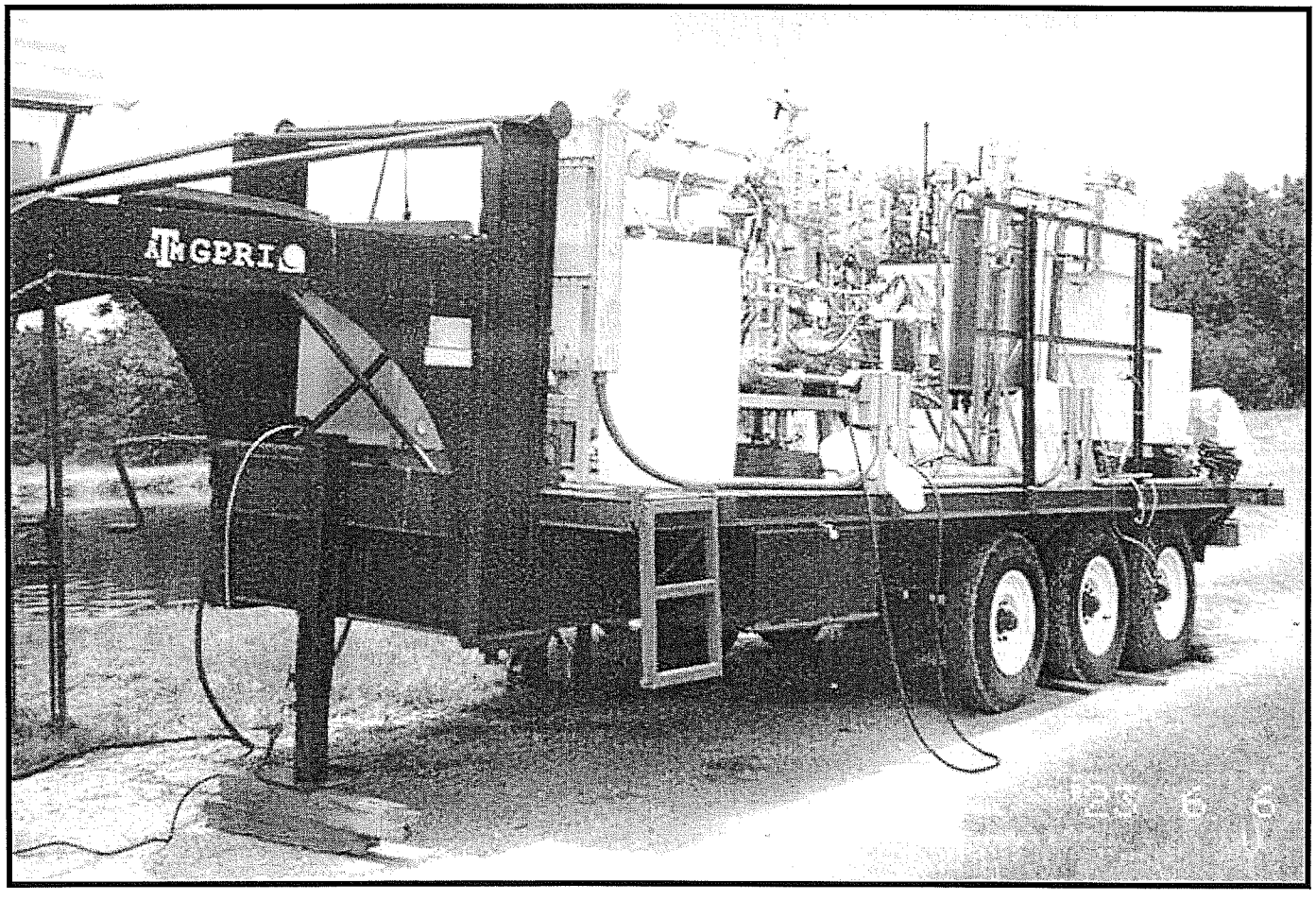
Small Cell Testing to Evaluate Membrane Performance





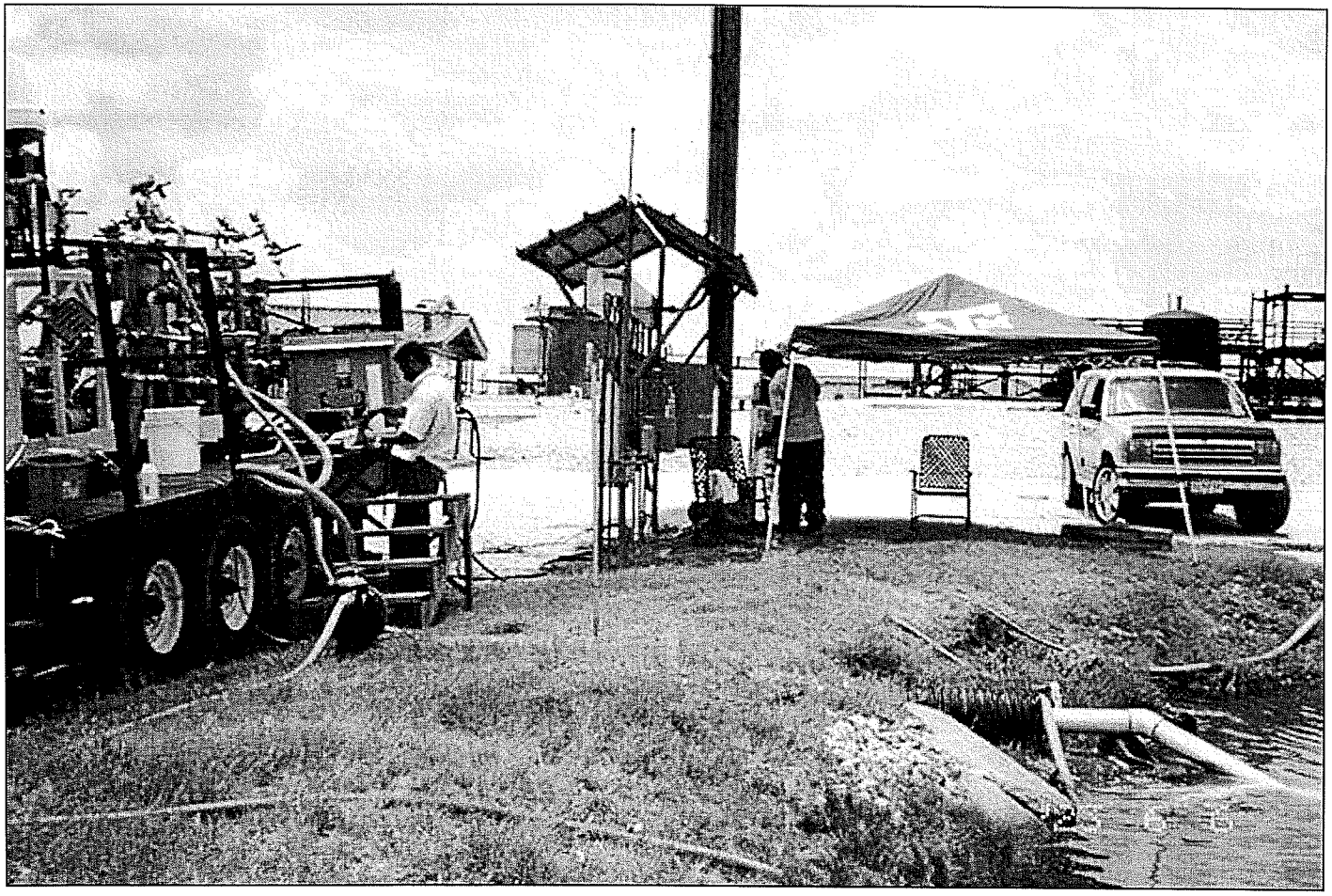
2. Description of the Technology

A&M Pilot Desalination Unit



2. Description of the Technology

Desalination Unit at Site



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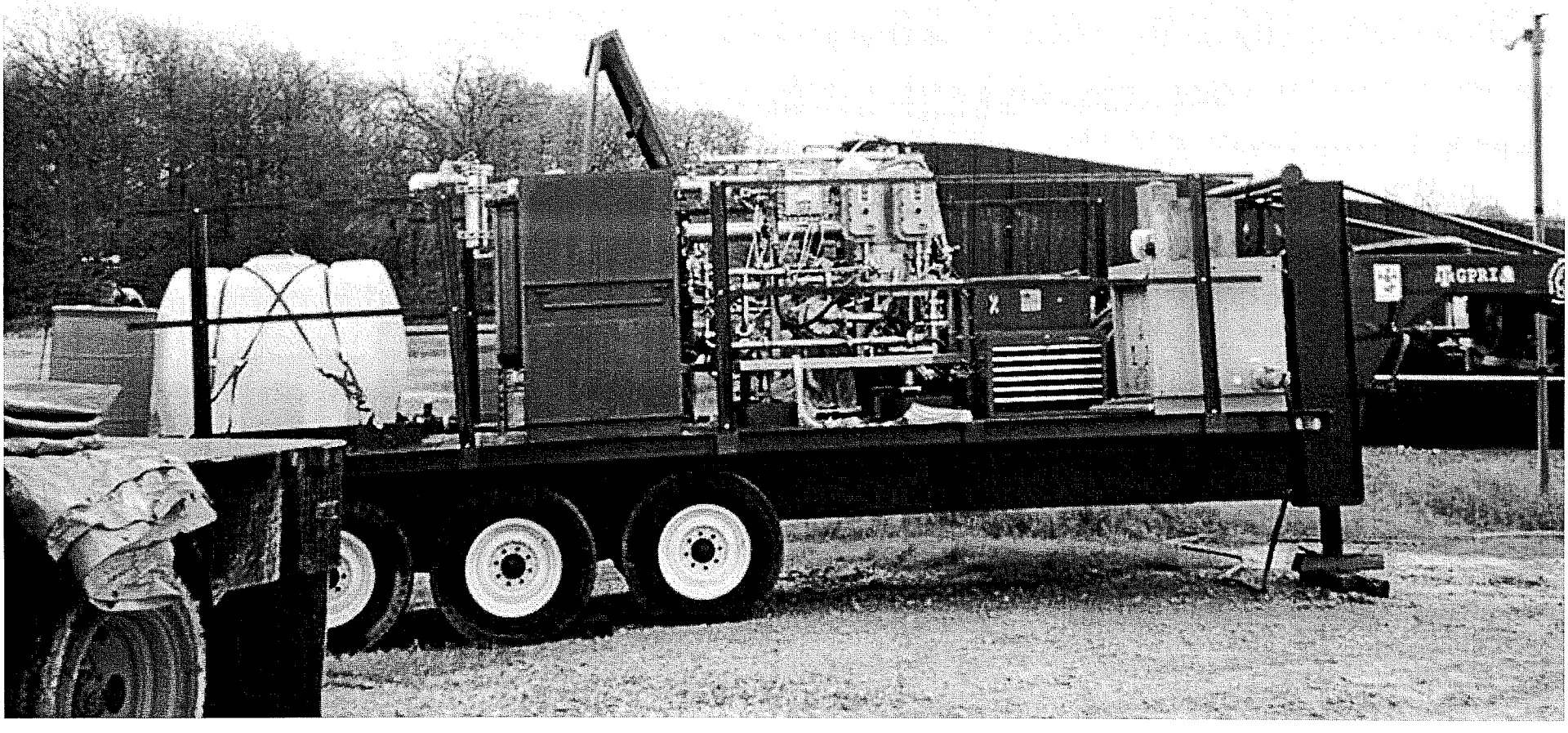
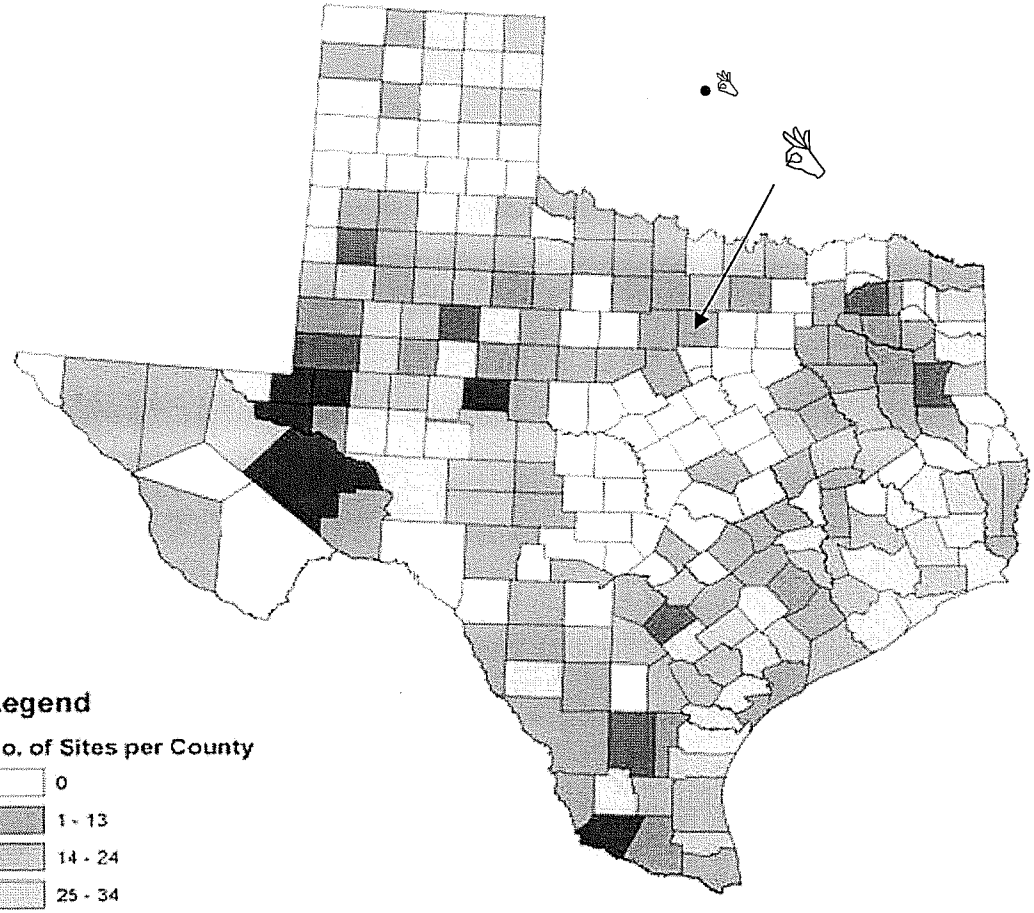


Concentration of Texas Produced Water Sites



Legend

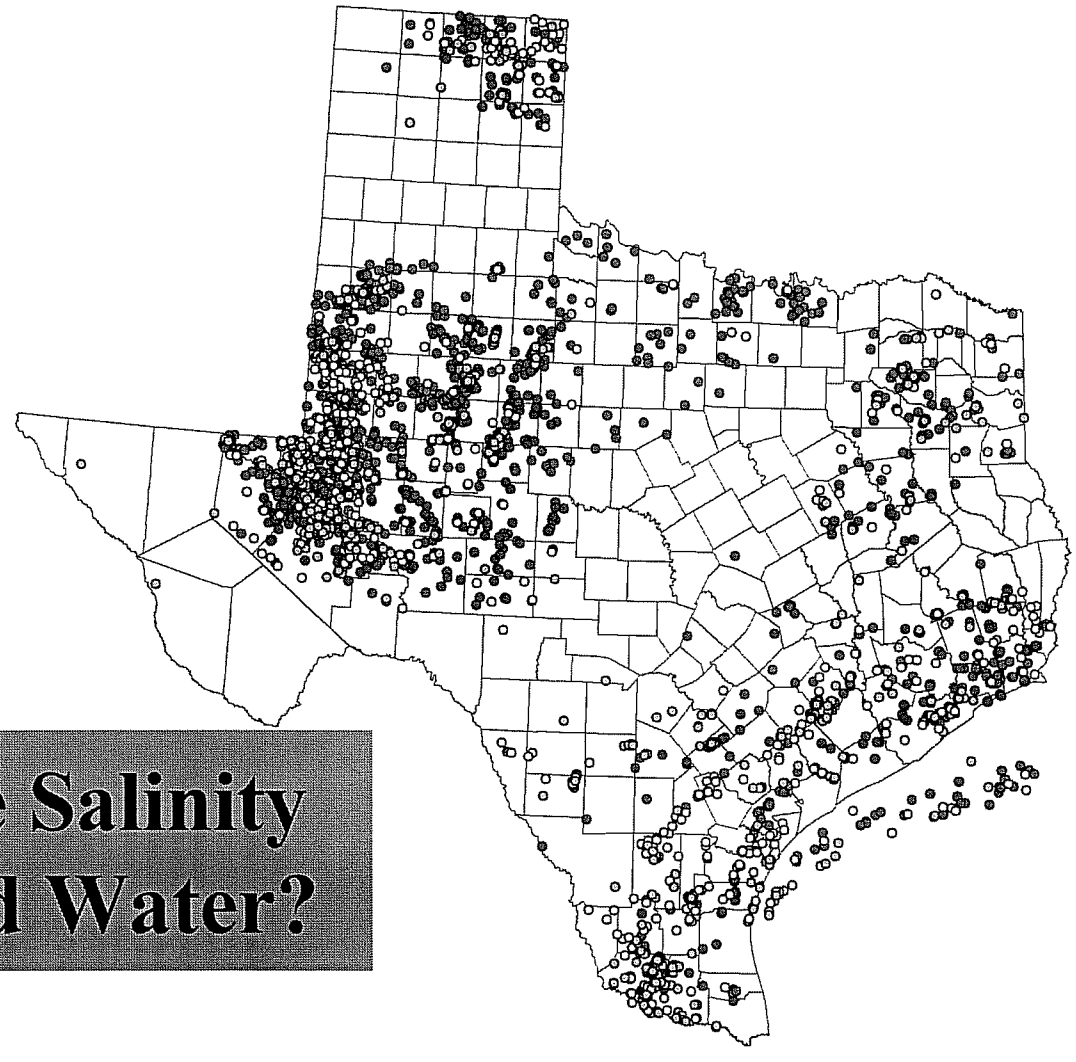
No. of Sites per County

- 0
- 1 - 13
- 14 - 24
- 25 - 34
- 35 - 575
- 56 - 84
- 85 - 120
- 121 - 238
- 239 - 346
- 347 - 733

0 30 60 120 180 240 Miles

Spatial Sciences Laboratory, 2004

What is the Salinity of Produced Water?



Legend

- Total Dissolved Solids < 10,000 ppm
- Total Dissolved Solids between 10,000 and 50,000 ppm
- Total Dissolved Solids > 50,000 ppm

N
W E
S

0 30 60 120 180 240 Miles

Spatial Sciences Laboratory, 2004

Desalination to produced fresh water for Agri-industry and Community Use

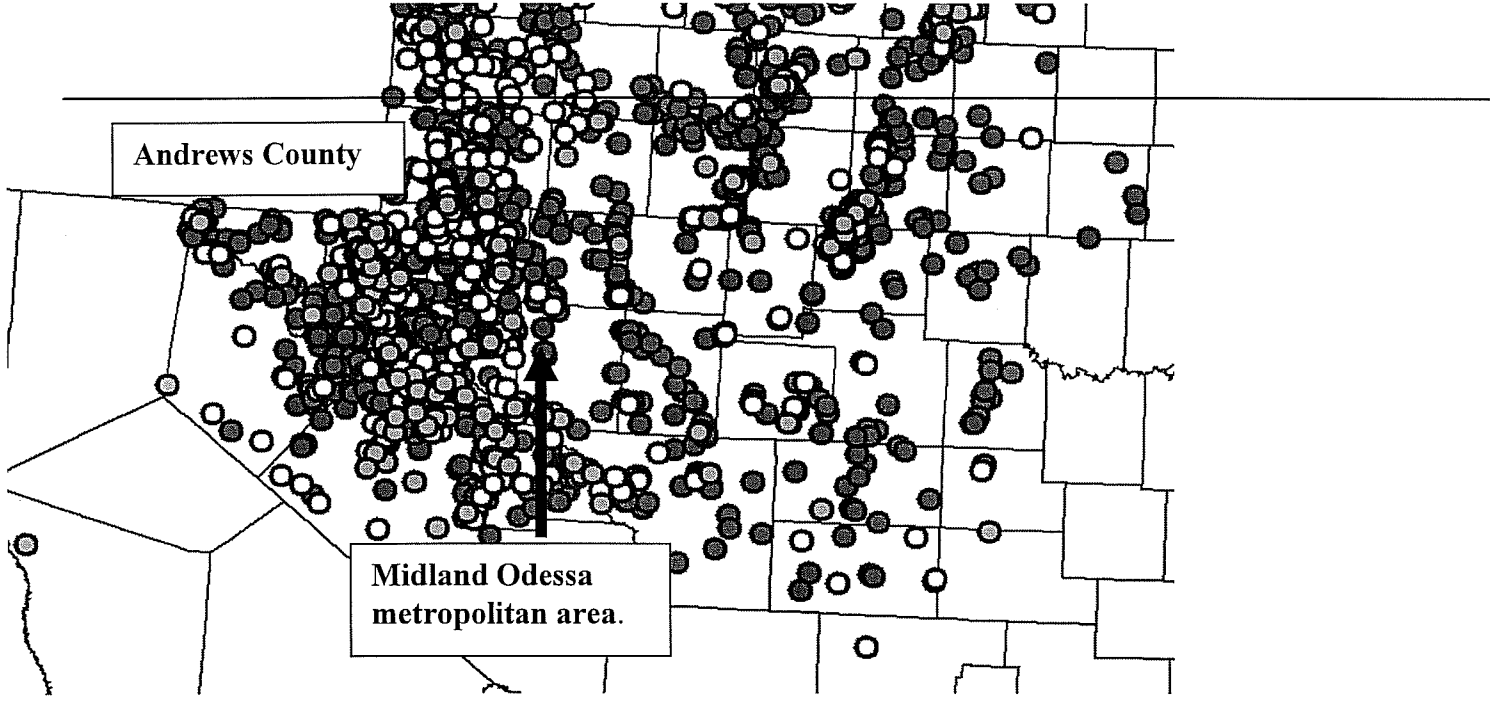
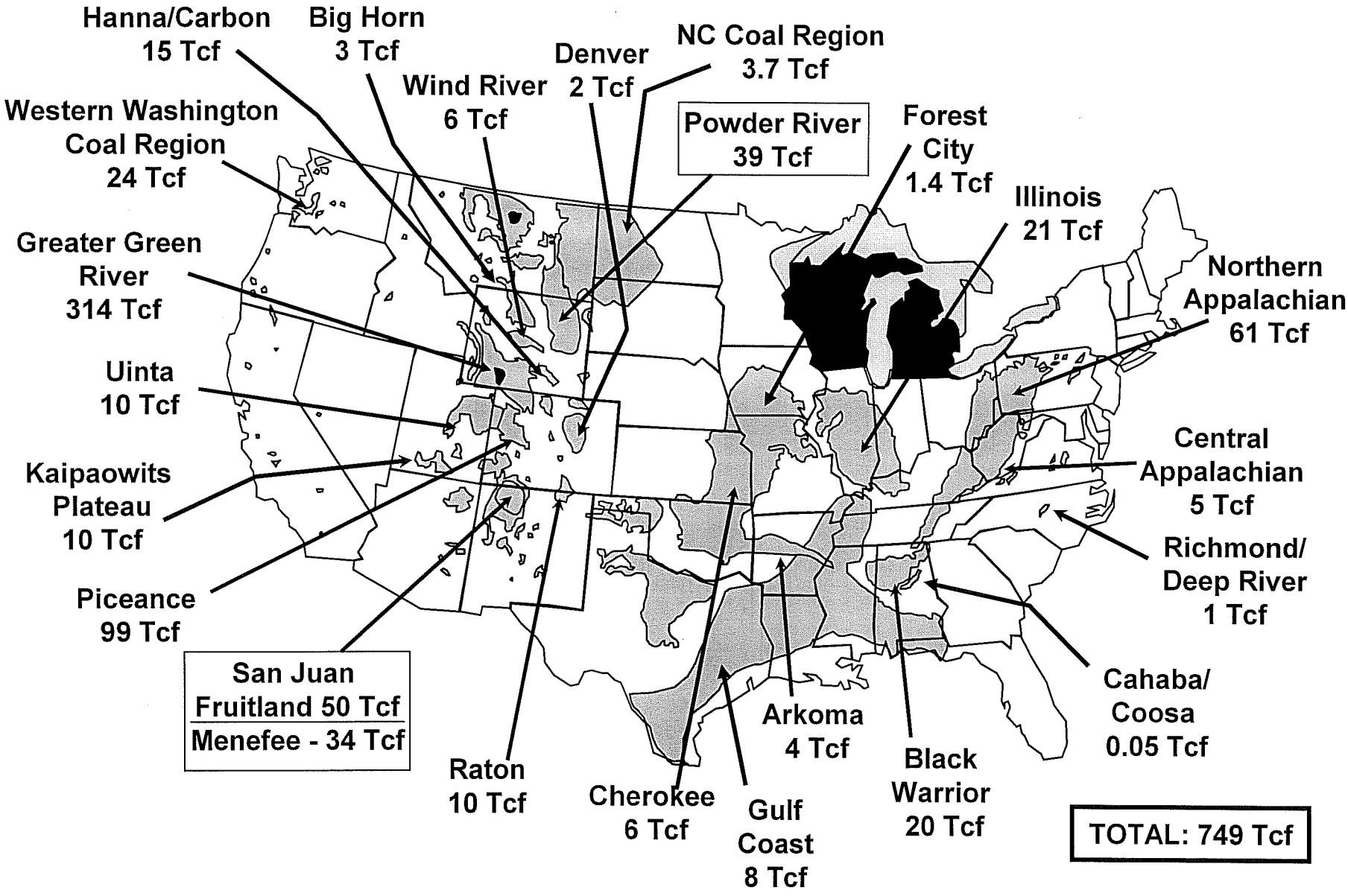


Figure 2 shows Texas produced water sites near the Pecos River, south of the New Mexico border. Produced water is classified into three categories. The green sites (~1/3) are brackish water (less than 10,000 ppm) and could be used for beneficial purposes after treatment. One-third of the sites has salinity (TDS) from 10,000 to 50,000 ppm, and is the focus of this project.
A state-wide map in color can be found at http://www.gpri.org/produced

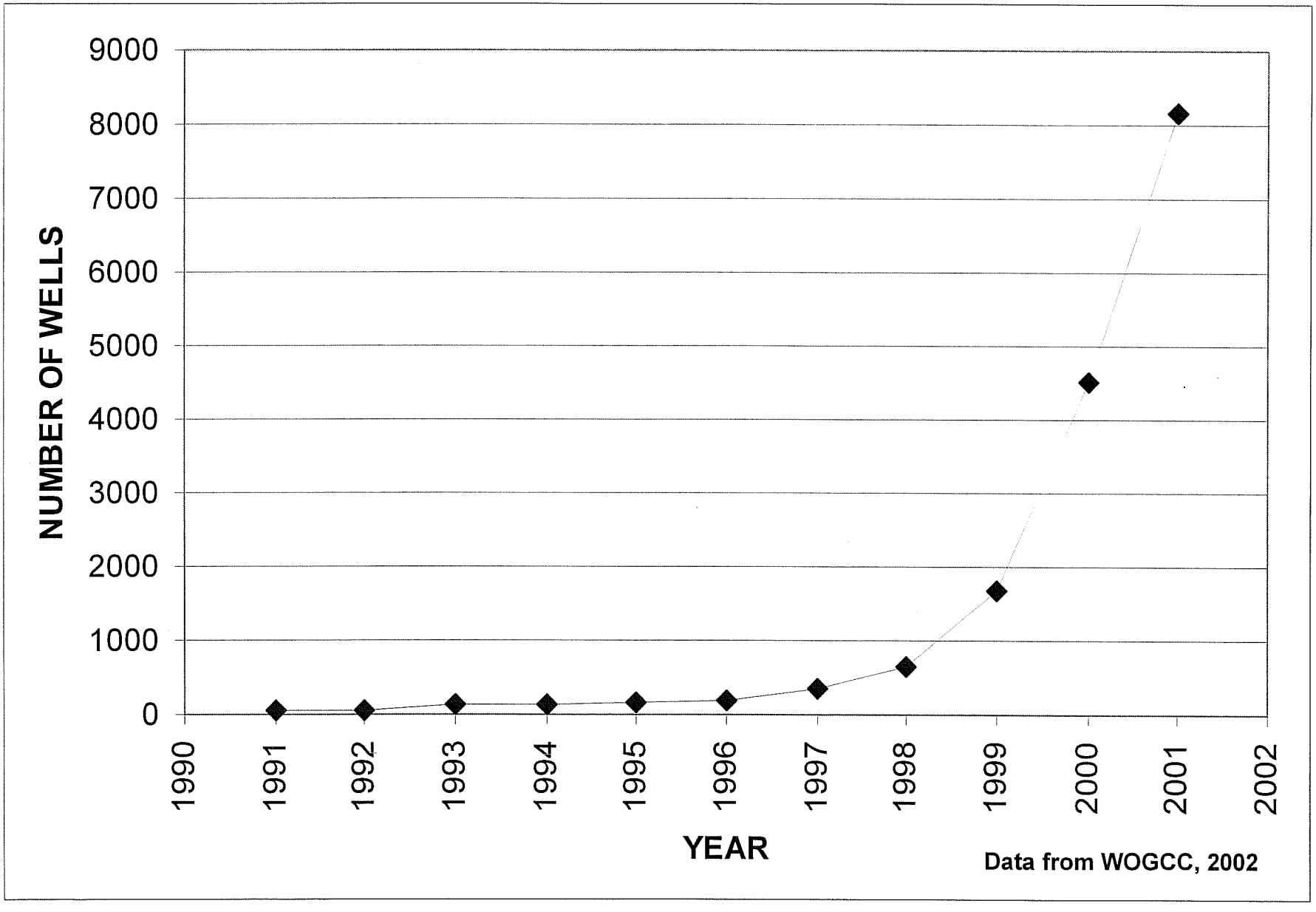
What is Water Worth in the Desert?

- *Casper Creek Oil Field discharges 1.7 MM gallons water a day (5.5 Ac. Ft per day) or 2,000 AcFt. Per year*
- *2,000 Ac.Ft. of water per well would raise almost 700 Acres of alfalfa in Monahans, Texas*
- *2,000 Ac. Ft would support more than 10,000 people (Americans) for a year*

U.S. COALBED GAS RESOURCES



NUMBER OF COALBED GAS WELLS, POWDER RIVER BASIN



POWDER RIVER BASIN
COALBED GAS PRODUCTION

- **Average gas production - 135 Mcf/d per well (August 2000)**
- **1.28 MMbw/d (average 518 bw/d per well; March 2000)**
- **Water/gas ratio is 3-4 bbl/Mcf early, dropping to 1-2 bbl/Mcf**
- **Reserves are 200 - 400 MMcf/well**

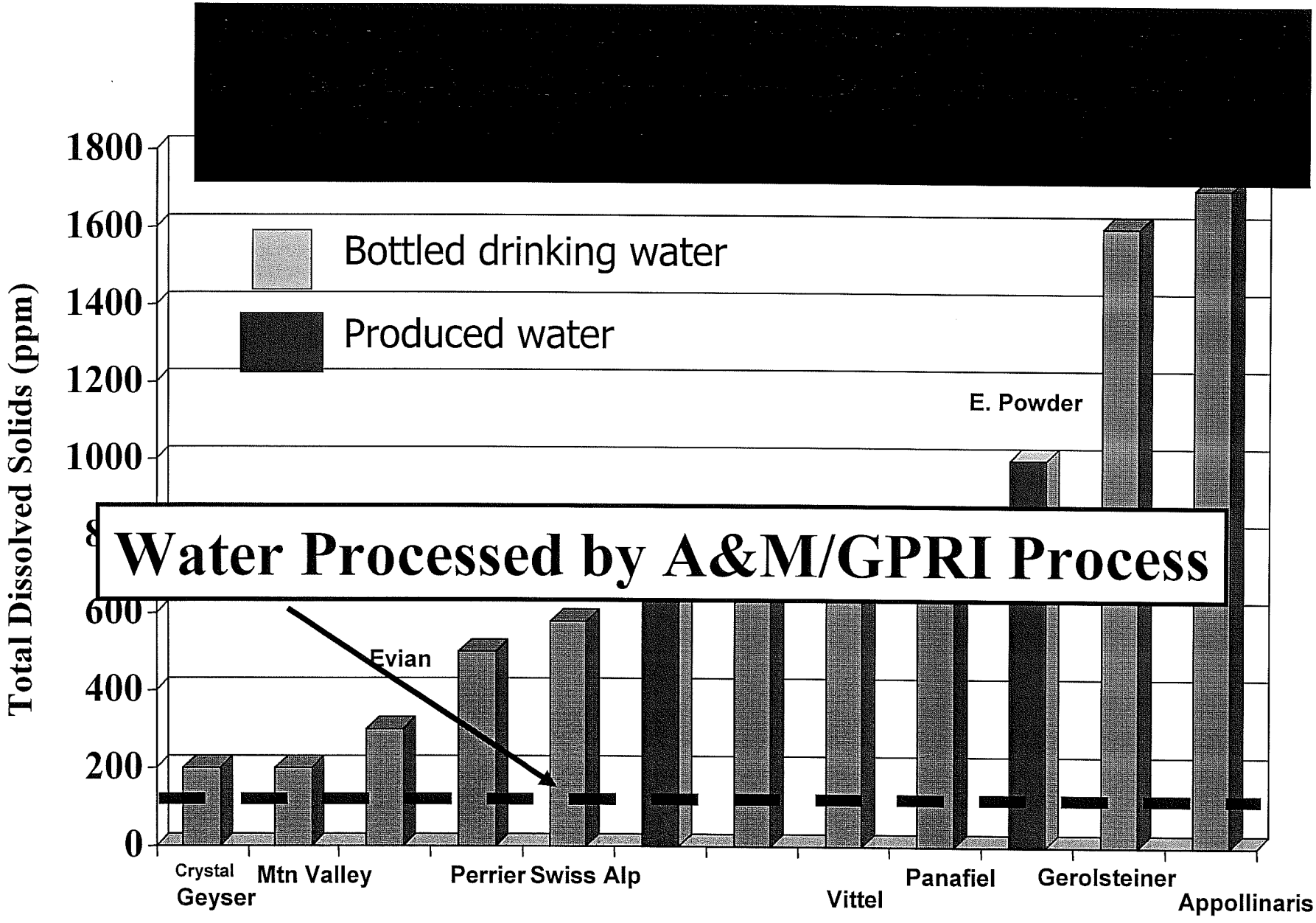
Data from Dwight's, after Pratt et al. ,1999; Montgomery, 1999; Rice and others, 2000

Viewpoint of an Environmental Group to Powder River Basin Development

- **The proposal for 51,444 wells**
- **17,000 miles of new roads**
- **20,000 miles of new pipelines and 5,300 miles of above-ground power lines**
- **Over 200,000 acres of soils and vegetation that will be stripped bare.**
- **500 to 1,200 surface discharge facilities for the water.**
- **From 1,800 up to 4,000 infiltration waste pits to handle produced water.**
- **The disposal of 1.4 trillion gallons of water over the project's life – over 4 million acre feet; enough water for 16 million people, or all the residents of Wyoming for 30 years.**

[redacted]

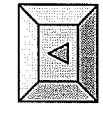
- ***http://www.powderriverbasin.org/***



Source: S. DeAlbuquerque, ConocoPhillips

COALBED GAS – PRODUCED WATER DISPOSAL METHODS

- **Reinjection into petroleum formations (Class II wells)**
- **Impoundments, evaporation, stream diffusion**
- **Beneficial Uses to Add Value**
  - **Reinjection into ground water aquifers**
  - **Watershed augmentation**
  - **Wetlands and habitat restoration (phytoremediation)**



A&M's Desalination Programs

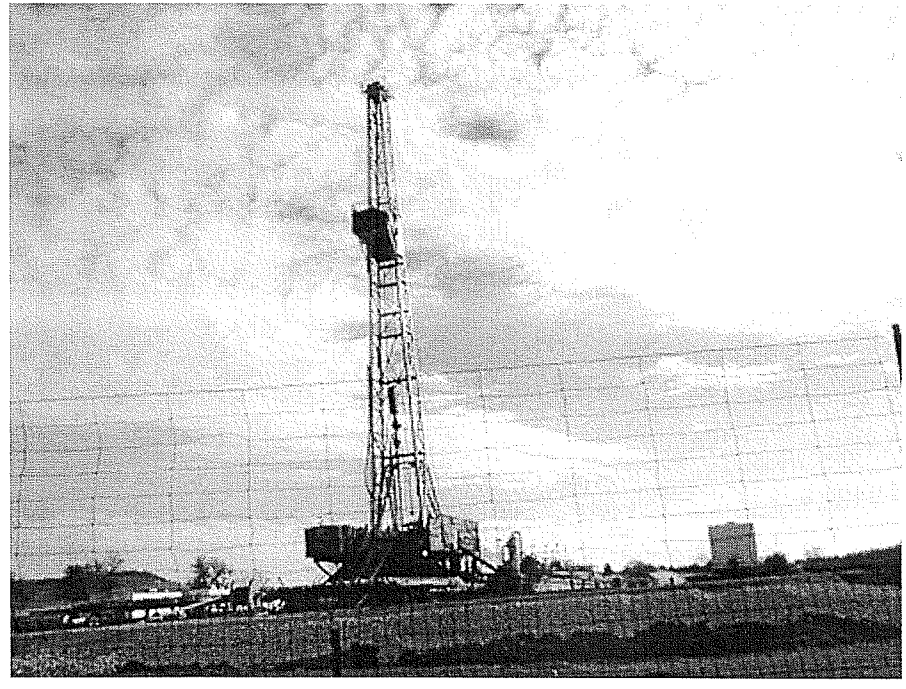
Goal of the DOE & GPRI Programs

to develop cost effective methods to desalinate oil field brine.

Goal of the A&M Program

to develop fresh water resources from unconventional sources.

Burlington Resources performs water fracs in the Barnett Shale using water from the Trinity River.



Demonstration units are to be used to treat the frac water for re-use.

For more info see:

www.mcog.org/ barnettlinks.html

Well Fracturing Operations

High-rate water frac treatments have been successful in Barnett Shale.

In 2001 Lacewell and the SWC looked at rapid unloading of fractured wells to stimulate production.

Burlington performs as many as 20 frac treatments per month in the Shale.

Demonstration units are to be used to treat the frac water for re-use.

For more info see:

SPE 80912, SPE 24884, SWC Republic Energy Report

Task 2:
Development in the Barnett Shale

Fresh Water from the Trinity River used for Fracturing Treatments

Devon Energy	~ 20 to 30/month
Burlington Resources	~ 20 /month
Other Operators	~ 30/month

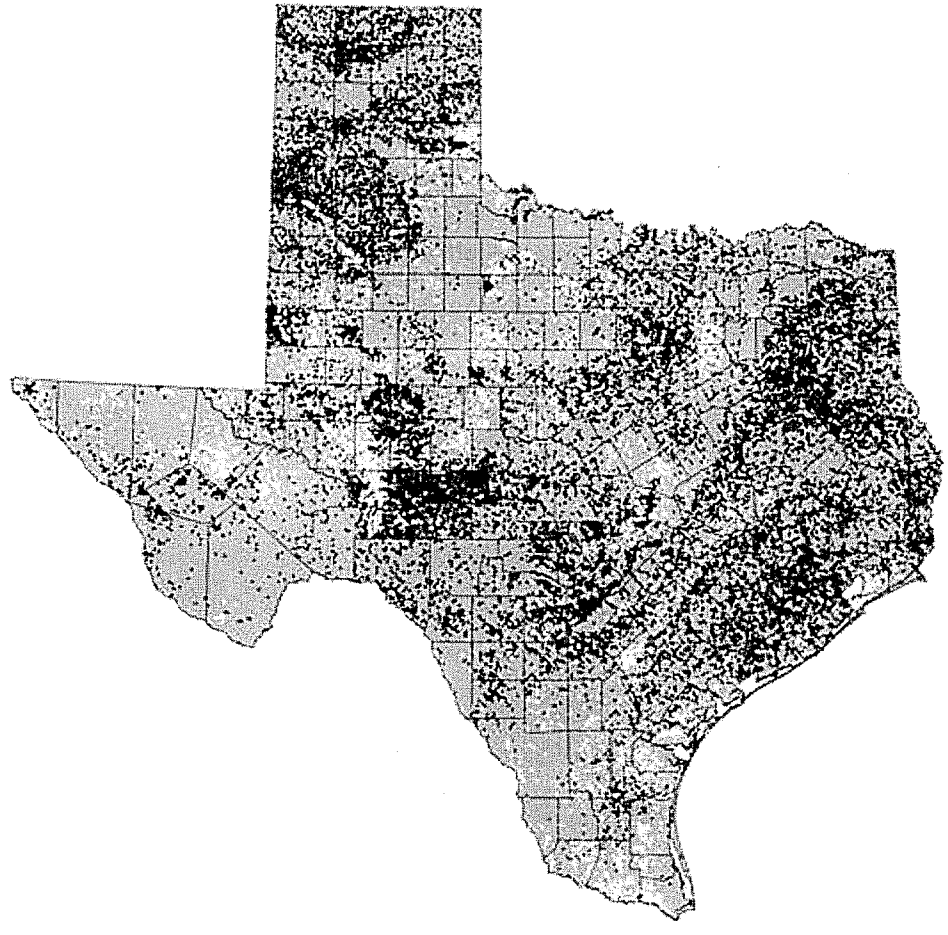
Each Treatment is ~ 25,000 Bbls

Recovery Water Handling **~ 80,000,000 gal/m.**

Data from Burlington Resources

Other Water Resources: TWDB Study

Texas Water Development Board identified the saline ground water aquifers in Texas. The study found more than 780 million acre feet of brackish aquifers that would be amenable to desalination.



For more Info see:

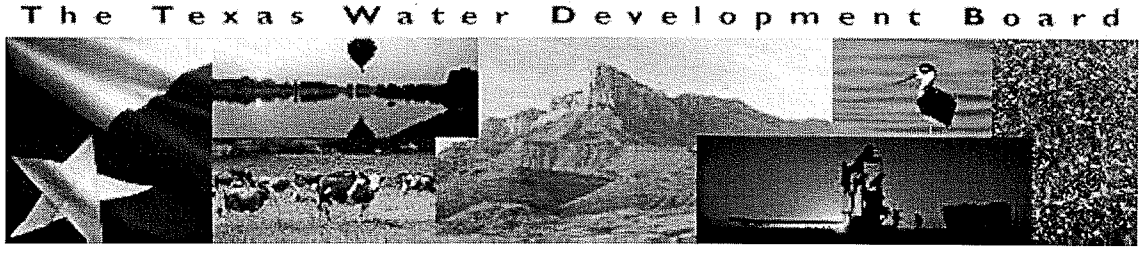
http://www.TWDB.state.TX.us

"Sale of West Texas Ground Water Angers Residents"

- **Headline Desert-Mountain News, Alpine Texas. October 23-29, 2003**

- **Susan Combs, State Agriculture Commissioner questions State Land Office's Position in Selling water rights to Private Corporation Rio Nuevo.**

Texas Water Development Board



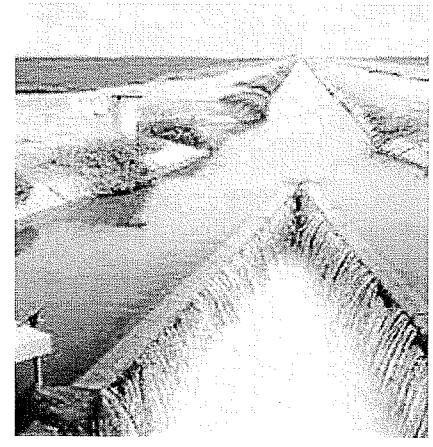
Please pass the salt: Using oil fields for the disposal of concentrate from desalination plants.

Inventory of Brackish Ground Water Aquifers in Texas

Feasibility of Desalination of Produced Water

Make Every Drop Count

Texas Water Resources Institute



For more Info see:

www.twri.tamu.edu

Support of A&M Produced Water Desalination

RAILROAD COMMISSION OF TEXAS

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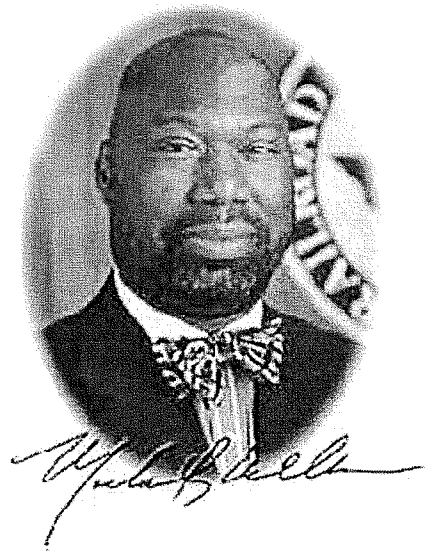
Choose a topic..

Commissioners

Williams endorses Texas A&M University research plan to clean up and reuse polluted water, or brine, produced from pumping oil and gas. Read articles published in **The Eagle** and **San Antonio Express**

Victor G. Carrillo
Commissioner



Michael L. Williams
Chairman

Charles R. Matthews
Commissioner

http://www.rrc.state.tx.us/commission

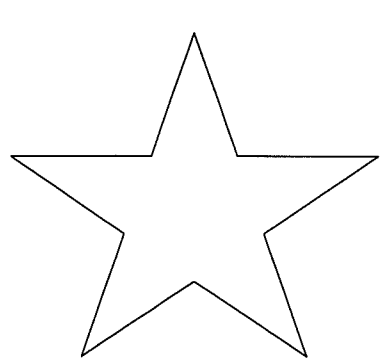
Texas A&M Desalination: Who We Are

- *Texas A&M University System*
  - Texas A&M Engineering (TEES)
  - Texas Water Resource Institute (TWRI)
  - Intl Agriculture Program
  - Global Petroleum Research Institute (GPRI)
  - Food Protein Science Separation Pilot Plant

- *State and Federal Partners*
  - Texas Railroad Commission (TRRC)
  - Texas Water Development Board
  - Texas Department of Agriculture
  - U.S. Department of Energy
  - U.S. Environmental Protection Council
  - U. S. Department of the Interior (BLM)

Thank You to

Texas A&M University Desalination Project



Rio Vista Bluff Ranch

2003 Lone Star Land Steward

Gulf, Prairies, & Marshes

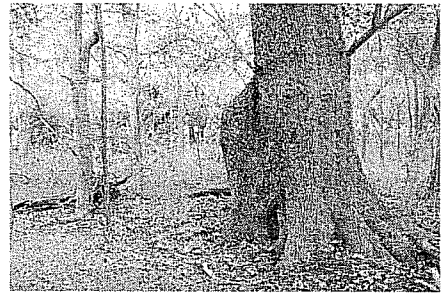
McFaddin, Texas

Victoria County

Rio Vista Bluff Ranch

- *Location-Four and one-half miles northeast of McFaddin, Texas along the McFaddin railroad road, in the seven and one half topographical quad, Bloomington southwest in Victoria County- Gulf Prairies and Marshes ecological area*

- *TOTAL ACRES- 2866*
- *Acres by Habitat Type:*
- *Timberland- 480*
- *Native Range/Brush- 1646*
- *Wetlands- 490*
- *Cropland- none*
- *Non-native pasture-250*



Rio Vista Bluff Ranch

- ***Commitment to Land Stewardship***

- *Jan Wheelis and David Moore work with, and support a wide variety of organizations that nurture and develop wildlife habitat, and conservation efforts. Jan & David work closely with TPWD, NRCS, TCE, TPWP, Victoria Soil & Water Conservation District, Goliad County Wildlife Management Co-op, & the Texas Master Naturalist Program. They are also founding members of the new Guadalupe River South Wildlife Management Association*

Rio Vista Bluff Ranch

Conservation Plan Map

Victoria SWCD

2638 Acres

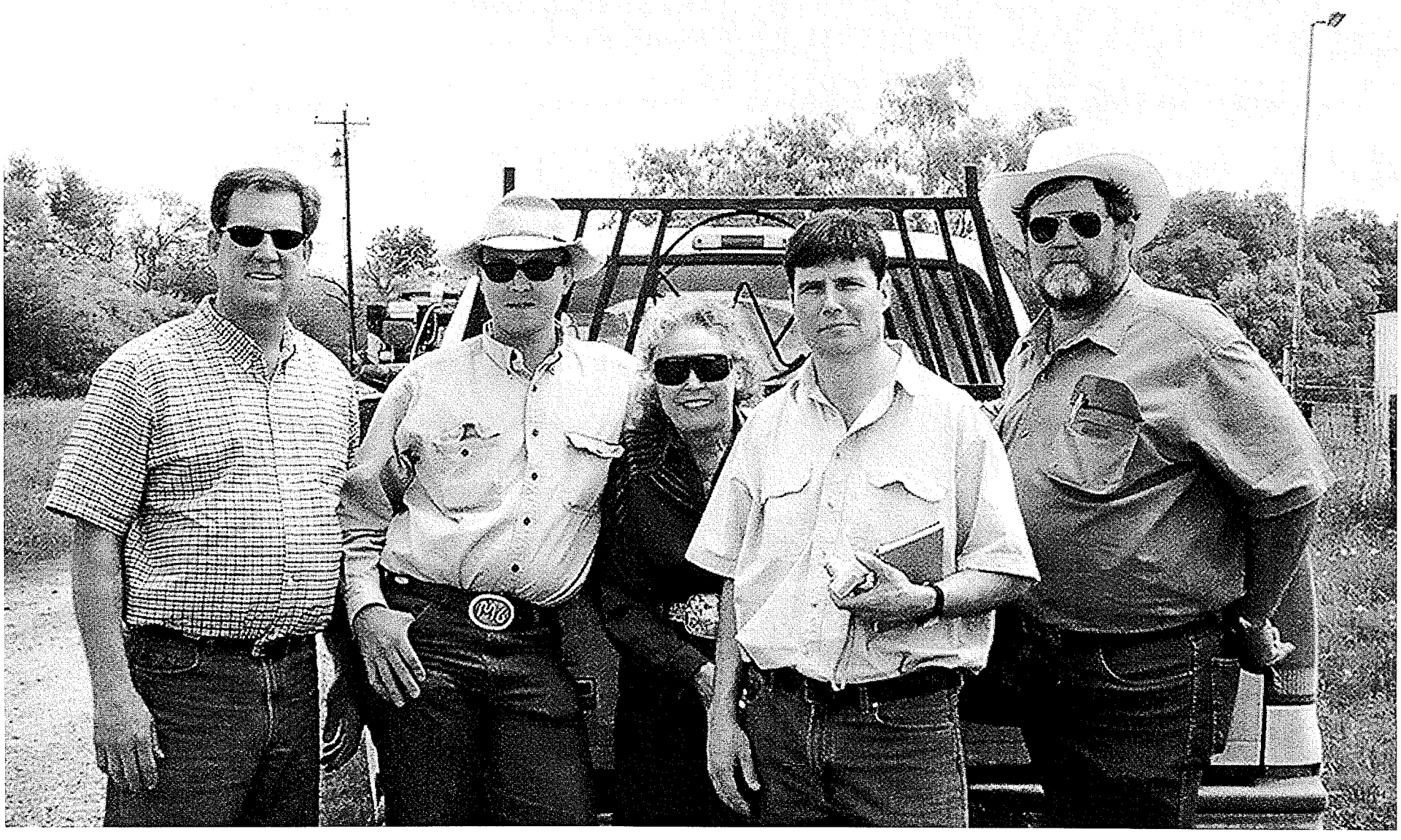
Date: 07/30/2004

USDA-NRCS

Leroy Mikeska

361-576-1129 Ext.


McFADDIN MERCANTILE




GOOSENECK
BLU